Presenting a Model to Determine Change Levels Based on Information Technology in Organizations

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Abstract: Scott Morton is one of the scholars in scope of management science has considered 5 levels for change based on Information Technology (IT) in a model and believes that organizations can pass these levels one by one using IT. The 5 levels include, automation, internal integration, business processes redesign, business network redesign and business scope redefinition. The present study aims at identifying and classifying those indicators that can be effective in determining change level based on IT in an organization. The study is also aimed at providing a framework for evaluating organizations in this regard. Hence, firstly, primary identification of indicators has been conducted through subjective study. Then, effective factors have been determined through referring votes of professionals. Afterwards, the factors were considered under paired comparisons of specialists, so that, relative weight of every one can be specified and factors can be ranked. General framework would be presented for evaluation of organizations in regard with levels of IT application using obtained information and then details would be specified through referring votes of professionals using the questionnaire which is provided for this purpose.

INTRODUCTION

Today, wide changes are occurred in business environment. Many technical, organizational and environmental factors have been integrated to each other in order to change business environment in terms of political, social, economic and technical perspectives. Organizations should preserve their stability and balance among turbulent waves of environmental changes, so that, they can be improved or remain stable. Dynamic stability means constant change in order to answer changes of conditions and utilization of new opportunities which is the only approach for current organizations. As IT is considered as a factor for accelerating environmental changes, it can be also considered as an inseparable component of changes of organizations architecture in order to meet relevant needs of the age of electronic economics. IT is considered as a main facilitator in the process of organizational changes. Resulted changes from IT or change based on IT is an issue that has gained attention of some scholars and thinkers around the world. Multiple levels of change based on IT are effective
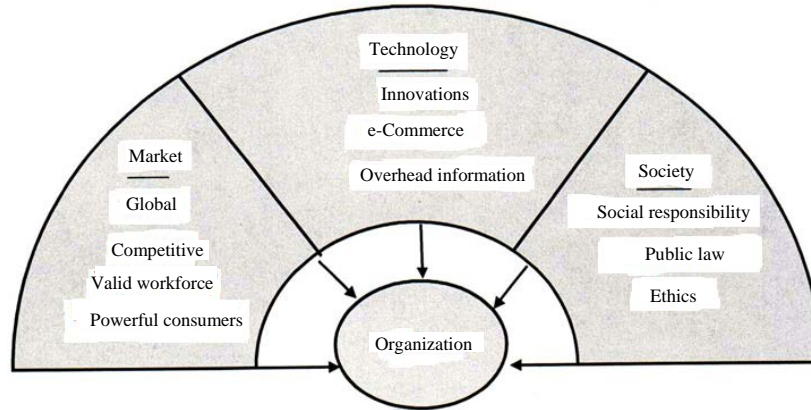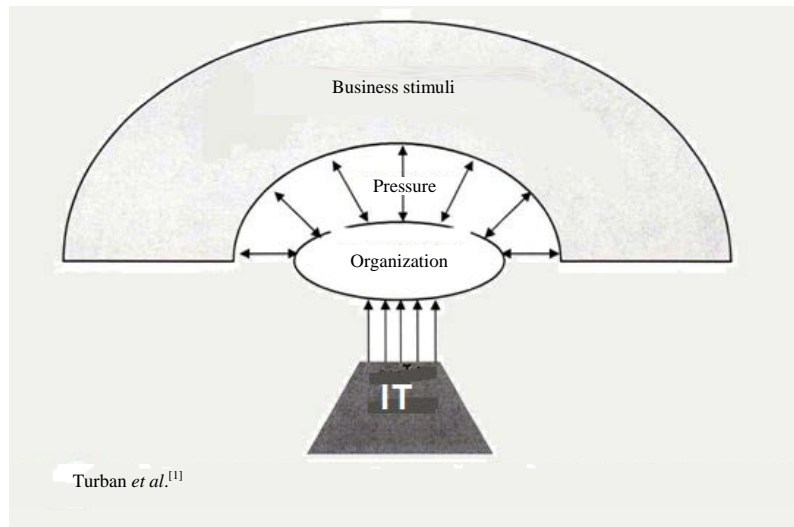
Fig. 1: Pressures of business

Fig. 2: Support of IT from organizational reactions

indicators in determining these levels and ranking the indicators using statistical techniques in order to evaluate organizations in this regard.

As it was mentioned, today organizations are under effect of business pressures on behalf of their external environment. These environmental pressures that can be named as induced pressures by the market, technology and society can make organizational environment dynamic, so that, organizational environment can become turbulent and they can't consider just traditional measures for their growth or even survival but they should consider innovative actions such as changing structures or processes (Fig. 1).

Therefore, organizations should follow their commercial success through constant changes in order to show response against changes of conditions and use new emerged opportunities. IT is considered as inseparable component of organizational changes in the current world and is also considered as

a factor for preserving stability and balance of the organization in the current changing environment as it is obvious in Fig. 2.

For better understanding the effect of environmental pressures on organizations and also reflection of role of IT in this regard, one can use another classic model that is provided by Turban *et al*.[1]. Framework of the mentioned model has been presented in Fig. 3. As it is obvious in Fig. 3, based on this model, organizations are formed by 5 principle components as follows:

- Organizational structure and corporation culture
- Management and business processes
- Organizational strategy
- Individuals and functions
- Information Technology (IT)[2]

These components have been restricted by the outside environment including social, economic and political
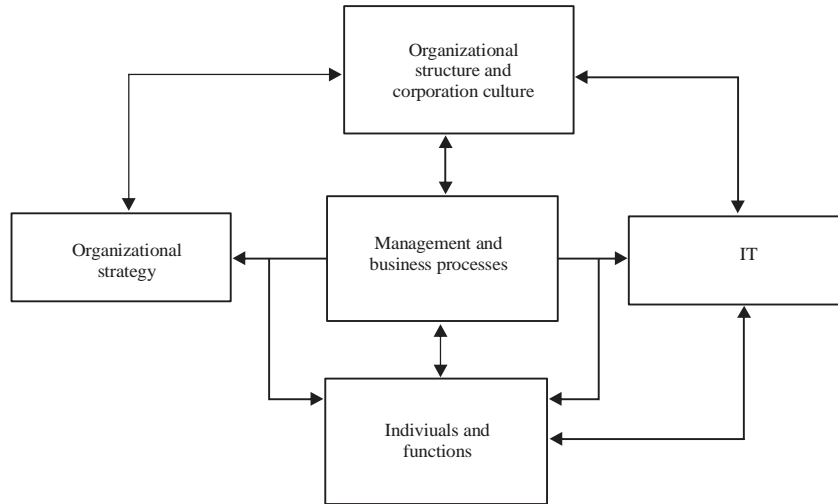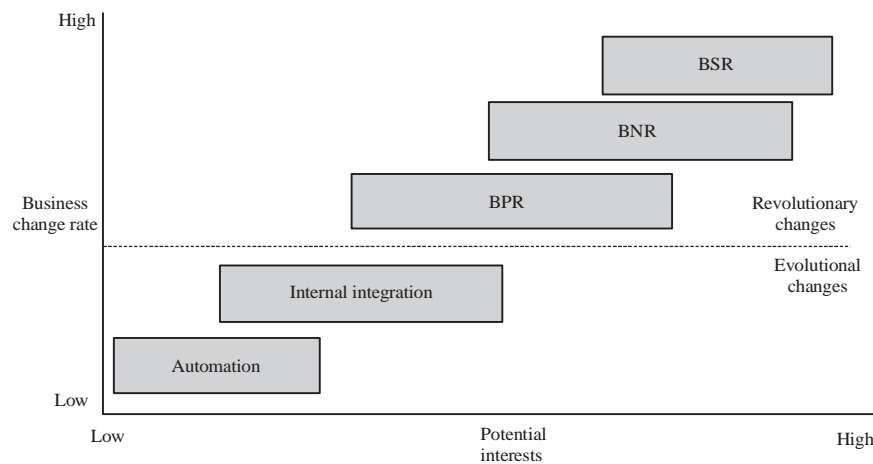
Fig. 3: Research model

Fig. 4: Application levels of IT

powers. The 5 components are in interaction with each other as an important change has not been occurred in the environment or in every component. When an important change is occurred, the system would become unstable and imbalanced and since, all components are depended on each other, it is necessary to change some or all of the internal components. For example, considerable change in organization's strategy is depended on changing structure of the organization. Unstable organizations can't be survived and advanced. Hence, organizations should response against environmental changes and pressures through changing organization's components such as IT.

Change based on IT: Due to the mentioned, organizational changes based on IT or in other words change based on IT is an issue that has gained attention of large number of researchers and scholars in scope of management and IT[3] (Fig. 4). During 1991 and 1994, Morton[4] has presented a theory which has been then expanded by Vankterman[3]. Based on the theory, changes based on IT are classified in a 5-level range as follows:

- Automation
- Internal integration
- Business Processes Redesign (BPR)
- Business Network Redesign (BNR)
- Business Scope Redefinition (BSR)

These 5 levels would be presented in form of two main aspects of change rate in business and also amount of potential interests which two first levels are revolutionary and need gradual changes in existing organizational processes. The two levels can be

considered as evolutional levels which need basic changes in business nature, comparing to other three levels. Figure 4 is a schematic display of the 5 levels. For better understanding, here, some definitions would be presented for the mentioned levels as follows.

Local automation: This level includes general issues in regard with automation based on IT in operation of business processes.

Internal integration: This level refers to rational and extensible issues in which abilities of IT in existing activities for business process would be investigated[5]. Two categories are important in this domain including organizational integration which can be considered by using IT in order to improve productivity.

Business processes redesign: The level covers reconfiguration of organization through using IT as the central core.

Business network redesign: The level is focused on reconfiguration of scope of activity and functions of organizational networks and is also focused on creation or delivery of products and services.

Business scope redefinition: This level investigates relevant issues of redefinition of organizational scopes and their components for improving level of business process. Such improvement of level can be achieved specifically through relations of products and services and also changes of business process status by replacing traditional capabilities with modern skills based on IT.

Primary identification of effective indicators in determining change levels based on IT: In order to identify main primary indicators, literature and also ideas of scholars have been referred. According to previous studies in regard with every change level including automation, internal integration, BPR, etc. and also investigation of previous studies about relevant topics, 17 important indicators are extracted that can indicate 5 levels of change based on IT. The 17 indicators have been identified based on relevant change level as follows.

Level 1; Automation:
- Number of computers to number of employees
- Using rate of independent applicable programs by organizational sectors
- Using rate of local and island networks by the organizational sectors
- IT skill literacy level in staffs (having computer skills based on patterns such as ICDL)

Level 2; Internal integration:
- Presence of comprehensive information systems in the organization[6]
- Linked sector of organization to information comprehensive system

Level 3; BPR:
- Identifying key processes for achieving organizational goals and determining their landscape
- Analyzing current status of key processes and determining level of suitable changes using IT
- Organization's key processes redesign

Level 4; BNR:
- Identifying out-organizational key processes
- Analyzing current status of out-organizational key processes and determining level of suitable changes using IT
- Out-organizational key processes redesign
- Percent of electronic customers of the organization
- Percent of electronic communication with suppliers
- Percent of electronic communication with commercial partners
- Percent of electronic processes associated with outside environment

Level 5; BSR:
- Business scope redefinition through using capabilities of the organization in scope of IT

However, it should be mentioned that some indicators can be related to two or more levels of change.

Determining effective indicators in change level based on IT: After primary identification of indicators through studying literature, a questionnaire would be provided for purpose of final determination of indicators. Using this questionnaire, ideas of experts and scholars would be apple in order to determine effective indicators in change levels based on IT.

In the mentioned questionnaire in order to determine effect of every indicator, 5 effectiveness levels would be considered, respectively as "very low", "low", "average", "high" and "very high" and would have scores, respectively, as 1, 2, 3, 4 and 5.

Applied questionnaire was distributed among scholars with work experience in management domain in order to collect their ideas and also to provide brief description of 5 change levels based on IT[7].

After collecting results of the questionnaire, all proposed indicators with scores more than 3 were considered as the effective indicators in determining change levels based on IT and were applied in next sections.

Ranking and determining weight of effective indicators in determining change levels based on IT: After specifying effective factors in determining change levels based on IT, now the indicators should be ranked and weight of every one should be determined in order to present the research model.

For this purpose, a questionnaire under the title of paired comparisons of effective indicators for determining application levels of IT was provided and distributed among experts and scholars with management experience in this domain and then questionnaire were collected.

After collecting results of survey, AHP method was applied in order to analyze the results. During several steps, weight of every indicator was determined and adjustment of matrixes of paired comparisons was also investigated. First, matrix D was estimated that is mean value of paired comparisons. It means that every element of matrix D is equal to geometric average of contradictory elements in paired comparison matrix as it is obvious in Table 1. Equal to AHP method, normalized matrix of D was estimated under title of ND and then under title of matrix W that indicates weight of every indicator. Weight and total rank of every indicator after the mentioned stage has been presented in Table 2.

Providing general model of evaluating organizations in order to determine change level based on IT: In this section, through applying previously obtained data, a model should be produced through which studied organizations can be evaluated and change level based on IT can be specified. In fact, the study rends to find that how one can achieve change levels based on IT in the organization after estimating every indicator separately. In this regard, several questions should be answered as follows:

As some indicators can be considered just in relation with one or more levels of change levels based on IT, how this issue can be considered in process of determining change level based on IT in an organization?

How much is minimum required rate for every indicator in every change level? For example, "number of computers to number of staffs" ratio should be to what extent, so that, requirements of level 1 (automation) can be covered? This question is also considered for same indicator in other levels. How much is minimum required score for an organization to pass one level of change successfully?

In order to answer the mentioned questions, firstly total schema of the model of determining change level based on IT would be determined and then details of the model would be specified using ideas of scholars. Total schema of the model is as follows: firstly, just those

indicators would be measured that are related to level 1 of changes based on IT (automation). Every indicator gains required score, if it has gained quorum determined by the questionnaire. This score is same weight that was determined in previous stage of the study. Total scores of level 1 indicator would be also estimated. If sum of scores is more than minimum rate of required scores for passing level 1, it means that the organization has passed level 1 of change based on IT successfully; otherwise, it means that the organization has not still passed level 1. If the organization becomes successful in passing every level, the process would be continued, until that it can't pass one level. It should be mentioned that minimum rate of required scores for passing one level successfully has been determined by the questionnaire.

According to the mentioned, questionnaire No. 3 was determined under the title of "determining minimum rate of indicators in every level of change based on IT" and was then distributed among a series of relevant experts and scholars.

In this questionnaire, 4 options have been considered for every indicator which one option should be marked by the respondent. In this questionnaire, just 9 indicators out of 17 indicators have been accepted and remained 8 indicators have been denied. These indicators have nature of 0 and 1; meaning that there are just two answers of "yes" and "no" or "there is" and "there isn't". On the other hand, through defining and identifying change levels, necessity or lack of necessity of the indicators could be found.

Through analyzing distributed questionnaires among scholars and experts, obtained results presented in Table 3 have been achieved. The best option is the option that has covered more than 50% of total choices for every indicator.

According to obtained results, best option has been obtained for all indicators and there is no need to redesign of the questionnaire. In regard with the most important question of the questionnaire, minimum rate of required score for successfully passing every level has been estimated to 80% according to ideas of scholars.

Here, due to obtained results, status of indicators and also quorum of scores for every level based on IT would be described.

Level 1; Automation: In this level, 4 indicators should be estimated as follows: ratio of number of computers to number of staffs; using rate of independent applications by organizational sectors; using rate of island and local networks by the organizational sectors and IT skill level in staffs. The indicators have been obtained, respectively, to 275, 240, 295 and 370. Minimum required ratio for gaining complete scores for r mentioned indicators in this

Table 1: Contradictory elements in paired comparison matrix as it is obvious

Co-relation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1	1/848	1/189	0/799	0/518	0/452	4140	0/304	0/247	0/452	0/334	0/277	0/343	0/468	0/878	0/713	0/304
2	0/672	1	0/493	0/885	0/439	0/383	0/389	0/311	0/294	0/453	0/367	0/311	0/351	0/452	0/537	0/627	0/253
3	0/841	2/03	1	0/631	0/771	0/799	0/486	0/325	0/281	0/55	0/429	0/343	0/452	0/595	0/565	0/53	0/271
4	0/251	0/13	1/586	1	0/811	0/639	0/707	0/595	0/357	0/616	0/493	0/516	0/628	0/733	0/896	0/76	0/275
5	1/929	2/276	1/297	1/233	1	0/841	0/55	0/356	0/325	0/616	0/504	0/351	0/537	1/052	1/488	0/829	0/356
6	2/213	2/611	1/251	1/565	1/189	1	0/504	0/374	0/273	0/586	0/424	0/313	0/445	0/565	0/841	0/799	0/351
7	2/414	2/568	2/057	1/414	1/819	1/984	1	1/565	0/885	0/951	1/886	1/609	1/996	2/589	2/81	1/565	1/147
8	3/293	3/212	3/08	1/682	2/81	2/671	0/639	1	0/493	0/091	2/276	1/052	1	1/212	2/769	1/542	0/965
9	4/047	3/407	3/562	2/8	3/078	3/657	1/13	2/03	1	0/639	1/052	0/829	1/929	1/162	2/8	1/769	1/091
10	2/213	2/206	1/819	1/622	1/622	1/707	1/052	0/917	1/565	1	1/251	1/091	0/475	0/771	0/885	1/157	0/436
11	2/995	2/723	2/328	2/03	1/984	3/359	0/53	0/439	0/951	0/799	1	0/771	0/475	0/518	0/565	0/562	0/388
12	3/609	3/212	2/913	1/939	2/847	3/193	0/621	0/951	1/207	0/917	1/297	1	0/829	1/586	2/519	0/841	0/429
13	2/913	2/847	2/213	1/591	1/861	2/246	0/501	1	0/518	2/104	2/104	1/207	1	1/886	2/81	1/897	0/616
14	2/135	2/213	1/682	1/364	0/95	1/769	0/386	2/81	0/86	1/297	1/929	0/631	0/53	1	1/542	0/872	0/374
15	1/147	1/816	1/769	1/115	0/672	1/189	0/356	0/361	0/357	131	1/769	0/397	0/356	0/648	1	0/616	0/356
16	1/403	1/595	1/886	1/316	1/207	1/251	0/57	0/648	0/565	0/865	1/778	1/189	0/527	1/147	1/622	1	0/799
17	3/293	3/96	3/692	3/638	2/81	2/847	0/872	1/233	1/091	2/294	2/577	2/328	1/622	2/671	2/81	1/251	1

1; No. of computers to staffs; 2: Using applied independent programs by the organization; 3: Use of local networks by the organization; 4: Skill level of staffs in scope of IT; 5: Existence of comprehensive information systems in organization; 6: Organizational sectors linked to comprehensive information system; 7: Identifying key processes of organization; 8: Analyzing status of changes using IT; 9: Business processes redesign; 10: Identifying out-organization key processes; 11: Analyzing key out-organization processes using IT; 12: Redesign of key out-organizational processes; 13: Percent of electronic customers; 14: Percent of electronic relation with suppliers; 15: Percent of electronic relation with commercial partners; 16: Relation of electronic processes with outside environment; 17: Business scope redefinition using IT

Table 2: Rank and weight of effective indicators for determining change levels based on IT

Rank	Indicators	Indicator's weight
1	Business scope redefinition using organizational capabilities in IT domain	1100
2	Redesign of organizational key processes	980
3	Identifying key processes in order to achieve organizational goals and determining their landscape	900
4	Analyzing current situation of key processes and determining level of suitable changes using IT	810
5	Percent of electronic customers of organization	795
6	Identifying out-organization key processes	770
7	Identifying out-organizational key processes	630
8	Percent of principle electronic processes associated with outside environment (electronic settlement, e-Marketing, e-Ordering, etc.)	555
9	Percent of electronic relation with the suppliers	550
10	Analyzing current status of out-organization key processes and determining level of suitable changes using IT	545
11	Presence of comprehensive information systems in organizational level	405
12	Percent of electronic relation with commercial partners	400
13	Amount of organizational sectors linked to comprehensive information system	285
14	Skill level of staff in domain of IT and similar skills such as ICDL	270
15	Amount of using local and island networks by the organizational sectors	15
16	Number of computers to number of staffs	275
17	Amount of using independent applied programs by the organizational sectors	240

Table 3: Effective indicators in evaluation of level 4 of change based on IT

Rank	Indicators	Total score	Minimum required rate for gaining score
1	Number of computers to staff	275	1
2	IT skill in staffs (ICDL skill)	370	1
3	Existence of comprehensive information systems in organization	405	1
4	Organizational sectors linked to comprehensive information system	385	1
5	Identifying key processes for realizing organizational goals	900	1
6	Analyzing current status of key processes and determining changes using IT	810	1
7	Key processes redesign	980	1
8	Identifying key out-organization processes	630	1
9	Analyzing current status of key out-organization processes determining changes using IT	545	1
10	Redesign of out-organization key processes	770	1
11	Percent of e-customers	795	1
12	Percent of electronic relation with suppliers	550	0.9
13	Percent of electronic relation with commercial partners	400	0.9
14	Percent of main electronic processes associated with outside environment	555	0.9

level is equal to 0.8. In addition, minimum required score for passing level 1 successfully based on IT (automation) is equal to 944.

It should be generally, mentioned about estimating score of every indicator that if an organization has gained required quorum, it would gain total scores; otherwise, it would gain score based on obtained ratio. For example, if in relevant estimations of level 1 the indicator "ration of number of computers to number of staffs" in an organizations equal to 0.7, gained score would be calculated as follows:

$$\frac{0/7}{0/8} \times 275 = 240/6$$

Level 2; Internal integration: In order to investigate level 2 of change based on IT, 4 indicators are required for determining change level in an organization including "number of computers to number of staffs ratio", "IT skill level in staffs", "existence of comprehensive information system in organization" and "rate of organizational sectors linked to comprehensive information system[8]". Scores of these indicators have been respectively equal to 275, 370, 405 and 385. Minimum required ratio for gaining complete scores associated with the mentioned indicators have been equal to 9, 0, 9, 0, 1 and 9 and 0. Clearly, minimum score required for passing level 2 successfully based on IT (internal integration) is equal to 1148.

Level 3; Business Processes Redesign (BPR): In order to investigate level 3 of changes based on IT, measurement of 7 indicators is required as follows: "number of computers to number of staffs", "IT skill level in staff", "presence of comprehensive information system in organization"[8], "rate of organizational sectors linked to comprehensive information system", "identifying key processes for achieving organizational goals and determining their landscape", "analyzing current status of key processes and determining changes level using IT" and "redesigning organizational key processes". Total scores for these indicators have been equal to 275, 370, 405, 385, 900, 810 and 980. Minimum required rate for gaining complete scores for these indicators in this level is equal to 1. Clearly, least required scores for passing this level successfully is equal to 3300.

Level 4; Business Network Redesign (BNR): In order to investigate level 4 changes based on IT, required indicators and also least required ratio for gaining complete scores in every indicator have been presented in Table 3. Clearly, minimum required score for passing the level successfully is 6696.

Level 5; Business Scopes Redesign (BSR): In order to investigate level 5 of changes based on IT, in addition to 14 mentioned indicators, measurement of "business scope redefinition using organizational capabilities in IT domain" is also required. Relevant score of the indicator is 1100. Least required ratio for gaining complete scores for all 15 indicators is equal to 1. Clearly, least required score for passing the level successfully is equal to 7576.

CONCLUSION

As it was mentioned before, today organization area under effect of various business pressures from the outside environment. These environmental pressures which can be divided topressures, resulted from market, technology and society, change organizational environment in a manner that they can't be limited to traditional actions such as cost reduction for the purpose of growth or survival but also they should consider innovative actions such as changing structures or processes. Hence, organizations should seek for growing their commercial situation through changing structures constantly in order to show response against changes of conditions and utilization of new conditions.

IT as inseparable component of organizational changes in the current world is a factor for preserving stability and balance of the organization in the current changing environment. Hence, one of the options that have gained attention of senior directors and programmers of organizations for facilitating the changes is using IT for creating organizational change. As Iranian organizations are at the initial steps of using IT, it could be imagined that the study can be effective for determining effective factors for these changes and presenting a framework for determining level of changes based on IT. The study can also help programming for change based on IT. Particularly, the presented framework is not limited to a specific organization and can be applied for any king of organization. Hence, one of the positive points of the study is its capability for applying it in all organizations. The presented approach can make it possible to evaluate current situation in organizations rapidly in regard with changes based on IT.

SUGGESTIONS

First of all, it is suggested to researchers and scholars to conduct another study after this study in order to modify and improve presented framework in this study through using it for evaluation of different organizations and comparison and analysis of them. Second suggestion for all organizations is using presented framework in this study in order to determine change level based on IT and as a result to recognize current situation, weakness and power points, opportunities and existing threats for the organization.

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